

ARIZONA STATE DEPARTMENT OF HEALTH

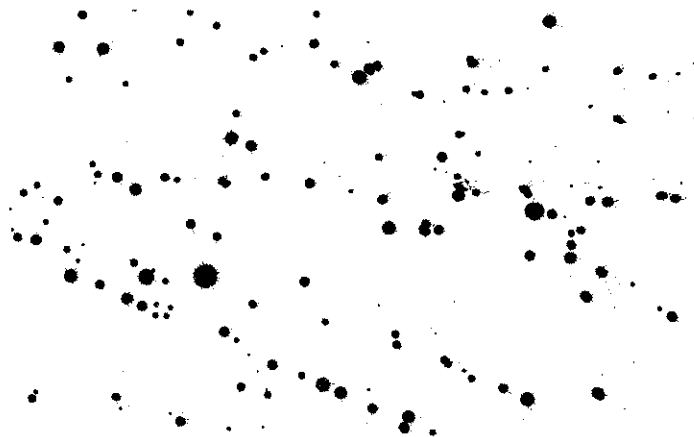
ENVIRONMENTAL HEALTH SERVICES

DIVISION OF AIR POLLUTION CONTROL

4019 North 33rd Avenue
Phoenix, Arizona 85017

PARTICULATE MONITORING NETWORK DATA

- 1970 -



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December 1971

ACKNOWLEDGEMENTS

Mr. James L. Guyton, Unit Leader, Air Quality Evaluation Unit, Division of Air Pollution Control, is responsible for the collection and analysis of all data contained in this report.

PARTICULATES MONITORING NETWORK DATA

1970

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PARTICULATE MONITORING NETWORK DATA

- 1970 -

I. INTRODUCTION

This is the second report of monitoring network data collected from high-volume samplers initially installed in 1969 for purposes of evaluating the magnitude of particulate matter in the Arizona atmosphere.

The report covers the calendar year 1970 and describes findings of continued operation and expansion of the 1969 network.

II. SAMPLING METHODS

Equipment Utilized

Procedures and equipment utilized are described in "Particulate Monitoring Network Data 1969", September 1970, Appendix pages i through iii.

Sampling Sites

The sampling sites for the 1970 study were classified into five source related areas:

- | | | |
|------------------------|--------------------------|------------|
| 1. Smelter Areas - Ajo | Claypool (Miami) | Douglas |
| Florence | East Plantsite (Morenci) | San Manuel |
| Superior | Winkelman (Hayden) | |

Winkelman was chosen as an alternate site for the Hayden area because a sampler operator could not be found in Hayden.

- | | |
|--|-------------|
| 2. Power Plant Areas - Davis Dam (Bullhead City) | Joseph City |
| 3. Cement Plant Areas - Clarkdale | |
| 4. Background Areas (no major sources) - Davis Dam (Bullhead City) | |
| Organ Pipe Cactus National Monument | |
| Page | |
| 5. Other Areas - Flagstaff | Yuma |

The sampling locations are shown on Figure 1. Davis Dam is listed under power plant and background areas because the Mohave Power Plant commenced operation in late 1970. Page will be reclassified under power plant areas in 1974 when the Navajo Power Plant begins operation.

Organ Pipe continued as a sampling site in order to determine the background concentration of particulates in the low desert areas.

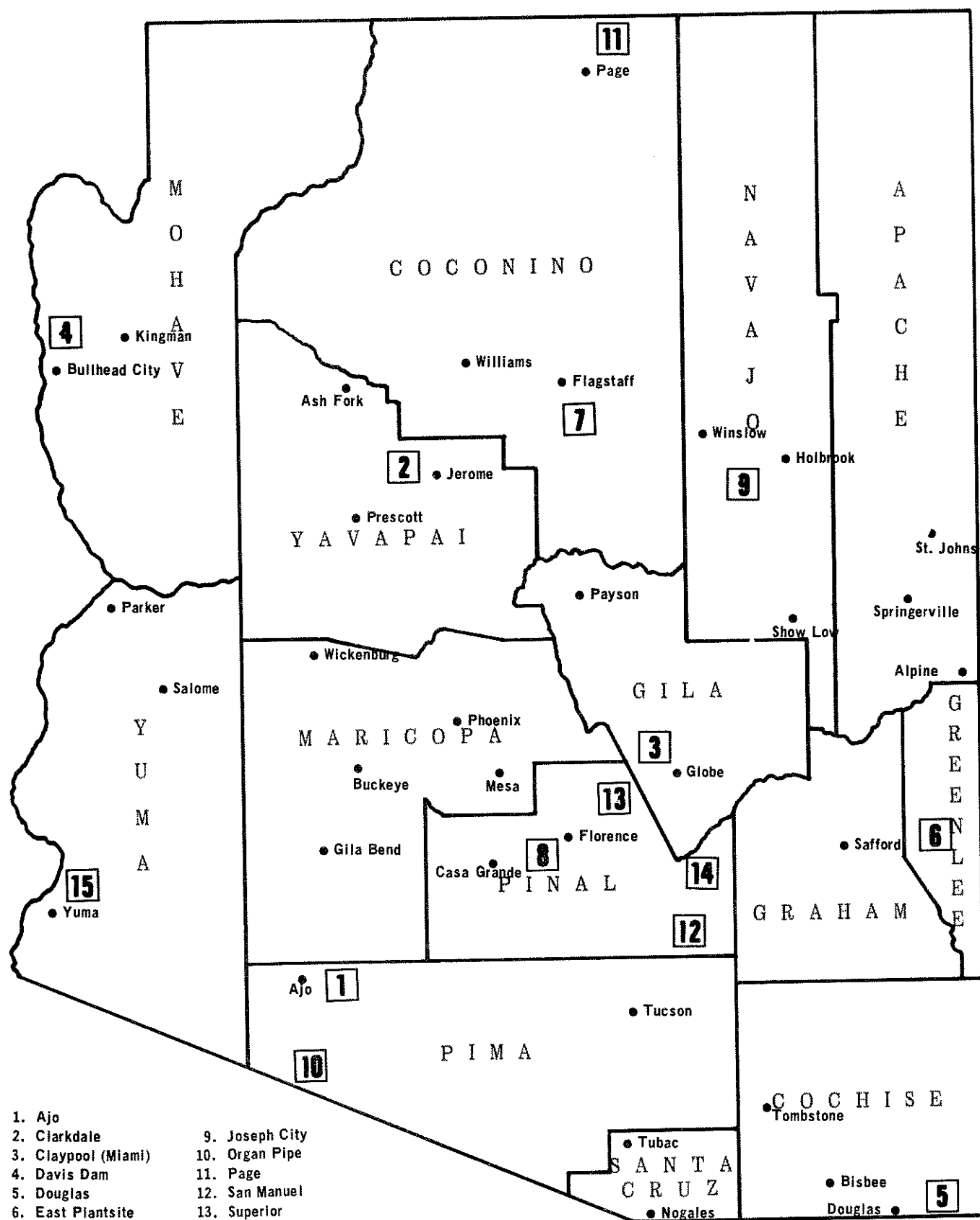
III. FINDINGS

I. Total Suspended Particulates

The findings are summarized in Table 1 and Figures 2 and 3. Frequency distributions for Clarkdale, Flagstaff, Joseph City, Page and Winkelman were not plotted on Figure 2 because of insufficient sampling data.

State annual and 24-hour standards were exceeded at 7 stations including: Ajo, Claypool (Miami), Douglas, Flagstaff, Florence, Superior and Yuma. Douglas evidenced the highest concentration of suspended particulates, 264 ug/m³.

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The estimated maximum 24-hour averages exceeded the 24-hour standard at least once at all sites with the possible exception of Page where limited data was available.*

The data obtained in Winkelman indicated that Winkelman is a poor sampling site for the Hayden area. A geometric mean of 69 ug/m^3 was obtained in Winkelman in 1970 whereas a mean of 224 ug/m^3 was observed in Hayden in 1969. Hopefully, a sampler operator can be found in Hayden in 1971.

Figure 3 is a graphic comparison of 1969 and 1970 data. All locations showed little change except in Superior where the 1970 geometric mean was 204 ug/m^3 as compared to 139 in 1969.

*The estimated maximum 24-hour averages were computed, applying the geometric mean and the standard geometric deviation to Larsen's Transform, a mathematical equation which estimates the maximum 24-hour average concentration. The measured maximum is lower than the estimated maximum because sampling occurs only one day per week. If samples were taken every day, the measured maximum would be closer to the estimated maximum.

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TOTAL SUSPENDED PARTICULATES
(In Micrograms per cubic meter)

Table 1

LOCATION	NUMBER OF SAMPLES	MEASURED		ESTIMATED MAXIMUM	GEOM. MEAN	STD. GEOM. DEV.
		Minimum	Maximum			
Ajo	47	25	366	395	83	1.7
Clarkdale	5	40	90	211	64	1.5
Claypool (Miami)	47	63	675	785	165	1.7
Davis Dam	46	10	91	175	31	1.8
Douglas	31	131	699	1,051	264	1.6
East Plantsite	47	16	148	287	51	1.8
Flagstaff	8	37	155	352	74	1.7
Florence	41	38	646	1,174	153	2.0
Joseph City	8	34	176	333	70	1.7
Organ Pipe Cactus Nat'l. Monument	24	18	83	122	37	1.5
Page	6	6	16	24	9	1.4
San Manuel	44	20	128	262	55	1.7
Superior	49	55	539	971	204	1.7
Winkelman	5	41	140	328	69	1.7
Yuma	27	35	371	752	98	2.0

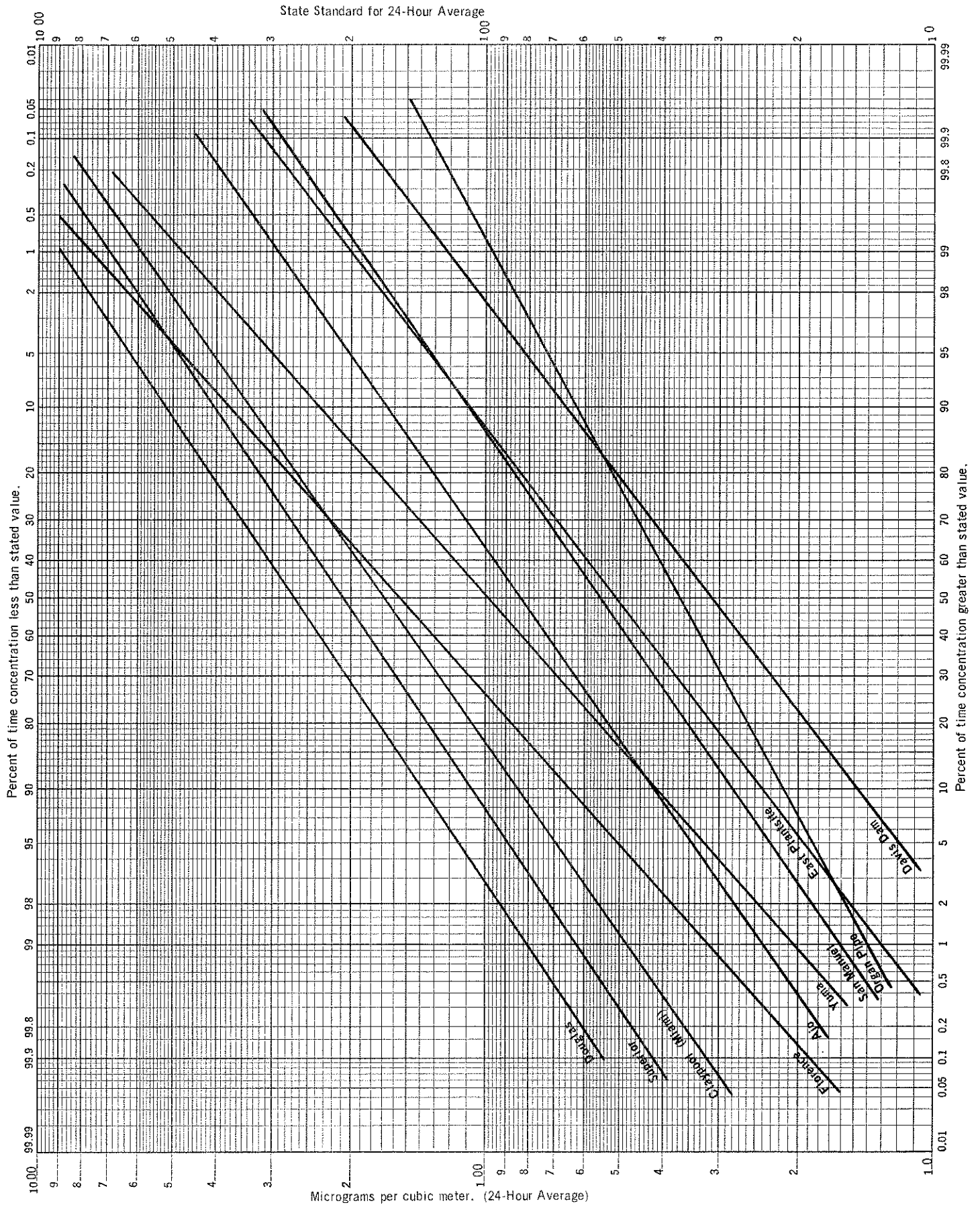
State Air Quality Standards - 24-hour average - limit of 100 micrograms per cubic meter
Annual geom. mean - limit of 70 micrograms per cubic meter

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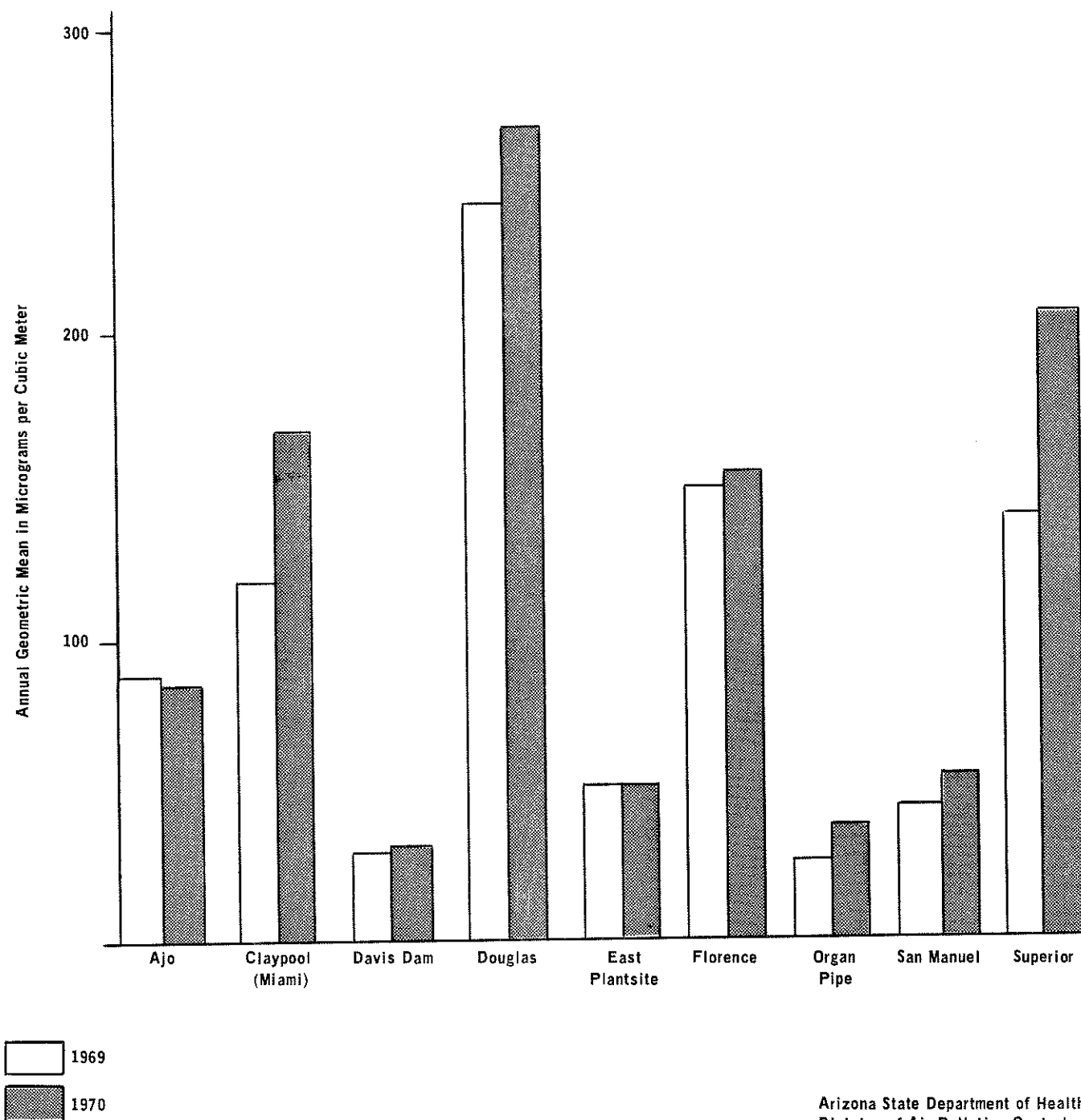
Figure 2

PERCENT OF TIME PARTICULATE CONCENTRATIONS GREATER AND LESS THAN STATE STANDARDS



1969 and 1970
COMPARISON OF TOTAL SUSPENDED PARTICULATES

Figure 3



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Table 2

1970

SPECIFIC CONSTITUENTS OF PARTICULATE MATTER

Arithmetic Mean in Micrograms Per Cubic Meter

Sampling Site	Benzene Soluble	Nitrates	Sulfates	Arsenic	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Nickel	Zinc
Ajo	2.1	1.0	6.7	.008	.015	.028	.019	2.5	11.0	1.2	.3	.09	1.1
Clarkdale	.4	.9	2.7	.003	.017	.047	.010	6.4	8.1	.9	.2	.2	1.8
Claypool (Miami)	5.7	.6	12.3	.012	.11	.039	.027	8.0	13.7	5.9	.3	.08	4.1
Davis Dam	.9	1.4	2.2	.005	.012	.026	.022	2.5	3.7	.6	.1	.08	2.5
Douglas	10.6	1.0	11.3	.018	.078	.049	.025	8.1	17.3	5.7	.5	.10	4.3
East Plantsite	1.1	.5	5.2	.003	.033	.031	.018	2.5	5.8	.5	.1	.06	3.1
Flagstaff	3.5	.6	3.9	.003	.015	.050	.020	2.2	12.5	2.8	.2	.30	2.2
Florence	1.9	2.1	8.2	.016	.13	.057	.075	3.1	17.4	2.8	.4	.38	4.1
Joseph City	1.2	.5	1.8	.005	.01	.40	.034	21.5	4.8	.7	.2	.10	2.0
Organ Pipe	.7	.8	3.7	.005	.006	.01	.003	1.7	2.4	.4	.1	.08	2.5
Page	1.5	.7	1.8	.004	.001	.009	.002	.2	.3	.1	.01	.01	.3
San Manuel	1.2	.6	6.2	.009	.019	.048	.028	1.3	5.5	.6	.1	.05	1.1
Superior	4.0	1.1	12.0	.016	.073	.051	.044	4.7	24.6	6.6	.6	.10	5.3
Winkelman	2.7	.6	8.2	.013	.027	.057	.044	5.7	11.7	4.6	.3	.23	3.3
Yuma	2.0	.9	2.0	.002	.016	.060	.040	.4	10.1	2.7	.4	.10	3.6

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2. Specific Constituents of Particulate Matter

A complete summary of the data is shown in Table 2.

2.1 Benzene Soluble

The highest annual average concentration of benzene soluble organics was 10.6 ug/m^3 in Douglas, almost identical with 10.4 ug/m^3 , the highest 1969 average. This may have been due to the sampler's proximity to heavy vehicular traffic at the international border.

2.2 Nitrates

The highest annual average, 2.1 ug/m^3 , was recorded in Florence. Extensive fertilization of this area with ammonia and ammonium compounds may have been responsible for the high nitrate concentration in the particulates from this area.

2.3 Sulfates

The highest annual average, 12.3 ug/m^3 , was observed in Claypool (Miami). In Superior and Douglas, the results were almost as high, 12.0 and 11.3 ug/m^3 , respectively. The sources of sulfates were the copper smelters.

2.4 Metals

The metals in highest concentration were cadmium, copper, iron, lead and zinc. The primary sources of these metals were the copper smelters.

2.41 Cadmium

The maximum annual average, 0.13 ug/m^3 , was in Florence, and the next highest was Claypool (Miami) where 0.11 ug/m^3 was recorded.

2.42 Copper

Joseph City showed the highest annual average of copper, 21.5 ug/m^3 . This is surprising since there are no copper smelters in this part of Arizona.

Copper was high in the smelter towns with values of 8.1 and 8.0 ug/m^3 recorded at Douglas and Claypool (Miami).

In Clarkdale, a value of 6.4 ug/m^3 was observed which might have been due to tailings piles remaining from abandoned copper mines.

2.43 Iron

Relatively high concentrations occurred in all smelter areas as well as Flagstaff and Yuma. The sources of iron in Flagstaff and Yuma might have been indigenous soils.

2.44 Lead

The highest concentrations were observed in Superior, Claypool (Miami) and Douglas. In Douglas, there was a second source in addition to the smelter, vehicular emissions at the border crossing.

2.45 Zinc

The highest concentrations of zinc were in Superior, Douglas, Claypool (Miami) and Florence.

REFERENCES

1. **Guyton, James L.**, "Particulate Monitoring Network Data - 1969", Arizona State Department of Health, Division of Air Pollution Control, September 1, 1970.
2. **Larsen, R. I.**, in Journal of the Air Pollution Control Association, "Larsen's Transform, A New Mathematical Model of Air Pollutant Concentrations Averaging Time and Frequency", Equation 22, Volume 19, Number 1, January 1969, pp. 24-30.

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**SULFUR DIOXIDE
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- 1970 -**

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Commissioner of Health**

**NORMAN E. SCHELL, DIRECTOR
Division of Air Pollution Control**

July 1972

ACKNOWLEDGEMENTS

James L. Guyton, Unit Leader, Air Quality Evaluation Section, Division of Air Pollution Control, analyzed and evaluated all of the data contained in the report.

Other Division of Air Pollution Control personnel, who contributed to the monitoring network data report, include: A. Bendyna, W. G. Holsinger and H. B. Nicholas who collected and reduced the data. M. G. Cubitto serviced the instruments used to collect the sulfur dioxide samples.

SULFUR DIOXIDE MONITORING NETWORK DATA

- 1970 -

I. INTRODUCTION

This is the second annual report of the sulfur dioxide air monitoring network program conducted by the Air Quality Evaluation Section of the Division of Air Pollution Control. It includes all sulfur dioxide data collected for the calendar year 1970.

The initial study, Sulfur Dioxide Monitoring Network Data - 1969, was published by the Division of Air Pollution Control in November 1971.

II. METHODS

A. Instrumentation

Beckman Instruments Model 906 Sulfur Dioxide Analyzers and Bristol Model 760 Dynamaster Strip Chart Recorders were placed at designated sites throughout the State. The 906 Analyzers use the coulometric method for the detection of sulfur dioxide.

B. Network Locations

Figure A (page 2) shows the nine sulfur dioxide network locations. Note that these sites should not be interpreted as places of maximum concentrations of sulfur dioxide (SO₂).

III. FINDINGS

A. Concentrations

Table 1 (page 3) summarizes the data for the nine locations which includes 1, 3, 24 and 72-hour average concentrations as well as data recoveries and annual averages.

B. Reduction of Sulfur Dioxide Emissions Required

Table 2 (page 4) shows the percent reduction in sulfur dioxide emissions required in order to meet federal and state air quality standards in 1971 at the nine locations.

IV. CONCLUSIONS

Sulfur Dioxide Levels

The sulfur dioxide levels in all seven smelter areas substantially exceed the ambient air quality standards established by the State Board of Health.

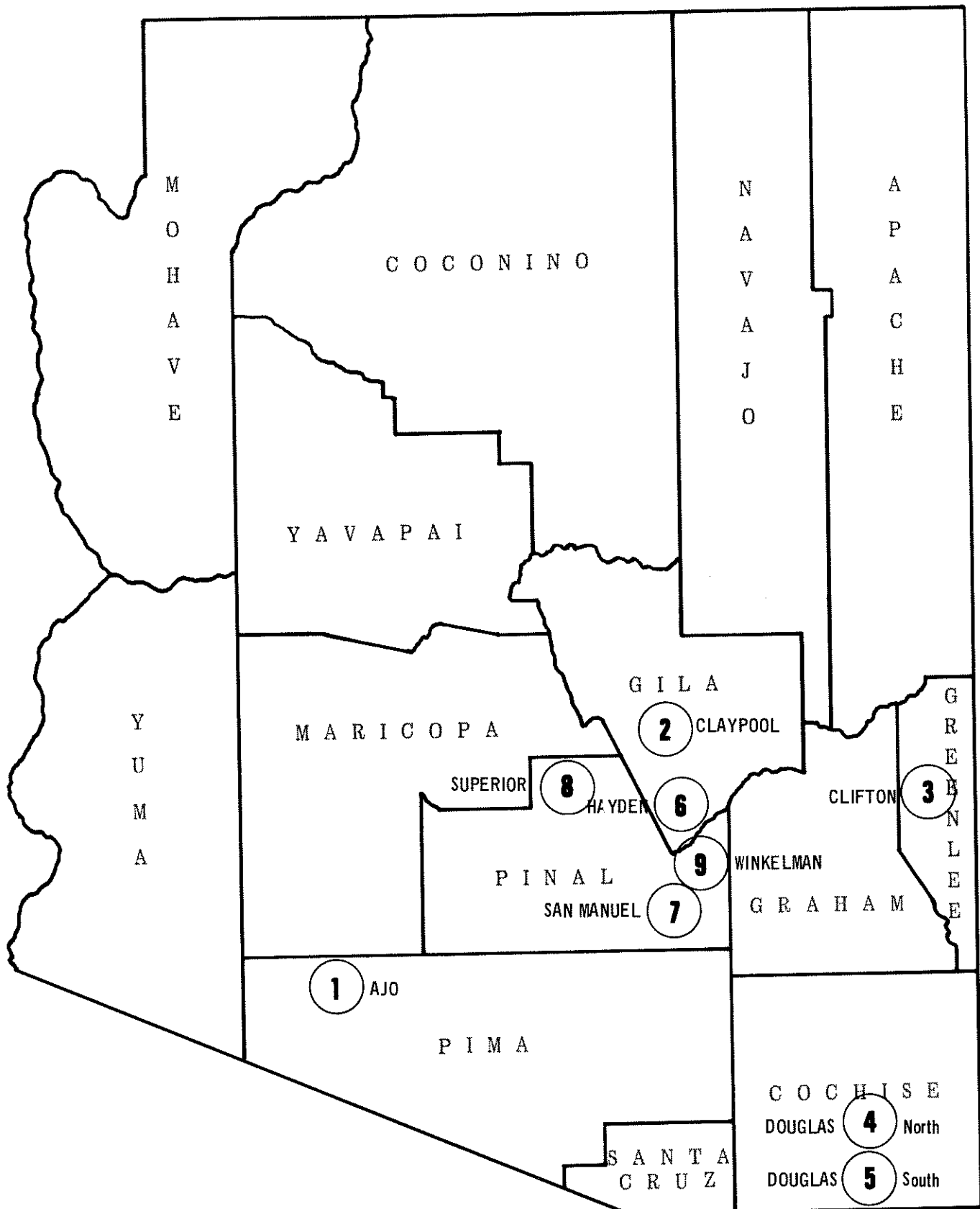
The highest levels of sulfur dioxide (SO₂) emission reductions required to meet State Air Quality Standards were:

STANDARD	PERCENT SULFUR DIOXIDE EMISSION REDUCTION REQUIRED TO MEET STATE STANDARDS	LOCATION
1-Hour	90	Hayden
3-Hour	81	Hayden
24-Hour	87, 81, 86	Hayden
STATE, FEDERAL		
Primary and Secondary Standards		
72-Hour	92	Hayden
Annual	90, 83, 88	Hayden

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FIGURE A

1970 SULFUR DIOXIDE MONITORING NETWORK



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SUMMARY OF SULFUR DIOXIDE MONITORING DATA

TABLE 1

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ANNUAL AVERAGES, MAXIMUM 1, 3, 24 and 72-HOUR AVERAGES AND DATA RECOVERIES
(Sulfur Dioxide Concentrations in Micrograms per Cubic Meter - $\mu\text{g}/\text{m}^3$)

LOCATION	ANNUAL AVERAGE CONCENTRATION	MAXIMUM CONCENTRATIONS				RECOVERY PERCENT
		1-Hour	3-Hour	24-Hour	72-Hour	
Ajo	189	4787	2681	1220	551	17
Claypool	48	3359	1702	425	202	57
Clifton	135	4498	2849	900	630	57
Douglas-ENE4	51*	2075	1751	485	221	70
Douglas-ESE3	44	3200	1780	463	353	79
Hayden	481	8649	6970	1877	1481	56
San Manuel	113	4507	2818	609	383	74
Superior	252**	4352	4200	1763	939	57
Winkelman	48***	4282	4282	714	309	54

* Station closed on 11-24-70

** Station opened on 3-1-70

*** Station opened on 8-25-70

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**SULFUR DIOXIDE EMISSIONS REDUCTIONS
REQUIRED TO MEET AIR QUALITY STANDARDS IN 1971**

TABLE 2

LOCATION	REDUCTIONS IN PERCENT								
	ANNUAL			1-HOUR	3-HOUR	24-HOUR			72-HOUR
	State	Federal Primary	Federal Secondary			State	Federal Primary	Federal Secondary	
Ajo	74	58	68	82	52	80	70	79	78
Claypool	0	0	0	75	24	41	14	39	41
Clifton	63	41	56	81	54	72	59	71	81
Douglas-ENE4	2	0	0	59	26	48	25	46	46
Douglas-ESE3	0	0	0	73	27	46	21	44	66
Hayden	90	83	88	90	81	87	81	86	92
San Manuel	56	29	47	81	54	59	40	57	69
Superior	80	68	76	80	69	86	79	85	87
Winkelman	0	0	0	80	70	65	49	64	61

AIR QUALITY STANDARDS
(In Micrograms per Cubic Meter ($\mu\text{g}/\text{m}^3$))

	ANNUAL	1-HOUR	3-HOUR	24-HOUR	72-HOUR
State	50	850	NS*	250	120
Federal Primary	60	NS*	NS*	365	NS*
Federal Secondary	80	NS*	1300	260	NS*

* NS - No Standard

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REFERENCE

Arizona State Department of Health, Environmental Health Services, Division of Air Pollution Control,
Sulfur Dioxide Monitoring Network Study - 1969, November 1971.

